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BAKER (MICHAEL) JR INC BEAVER PA
NATIONAL DAM SAFETY PROGRAM. CARROLL DAM (STONY CREEK NUMBER 10--ETC(U))
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DACW65-78-D-0016

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POTOMAC RIVER BASIN

Name Of Dam: CARROLL (STONY CREEK NO. 10)

Location: SHENANDOAH COUNTY, STATE OF VIRGINIA

Inventory Number: VA 17102

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LEVEL II

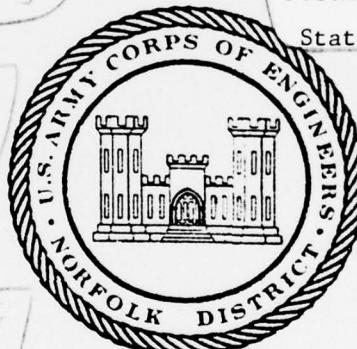
PHASE I INSPECTION REPORT

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⑩ Michael
/ Baker III

⑪ Aug 78

⑫ 64 P.



⑬ DACW65-78-D-0016

PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

AUGUST 1978

BY

MICHAEL BAKER, JR., INC.
BEAVER, PENNSYLVANIA 15009

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20. Abstract

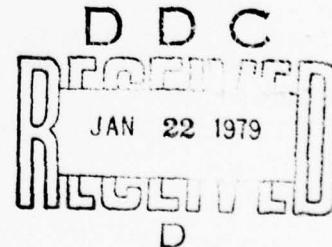
Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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NAME OF DAM: CARROLL

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Carroll
State: Virginia
County: Shenandoah
Stream: Alum Run, Tributary to Stony Creek
Date of Inspection: 2 June 1978

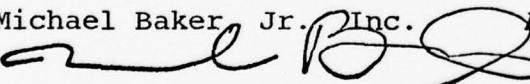
BRIEF ASSESSMENT OF DAM

Carroll Dam is an earth dam approximately 70 feet high and 601 feet long, owned and operated by Colonel C. C. Hamm and designed by the Soil Conservation Service on the Stony Creek Watershed as part of the Potomac River Watershed Project. The visual inspections and review of engineering data, made in June 1978, indicate no serious deficiencies requiring emergency attention. No evidence of unstable slope conditions or seepage was observed.

The crest height of the dam is designed for a freeboard hydrograph which approximately equals the Probable Maximum Flood; therefore, the embankment will not be overtopped. The absence of seepage and sloughing indicates that the embankment may have an adequate factor of safety. However, the stability analyses done during the design of the dam do not represent as-built conditions.

It is recommended that stability analyses be performed using the as-built embankment section. The minor erosion on the downstream slope of the embankment and on the left slope of the emergency spillway should be repaired as part of the annual maintenance program of the Lord Fairfax Soil and Water Conservation District. The primary spillway riser should also be cleaned of trash and debris.

Michael Baker, Jr., Inc.

 APPROVED:

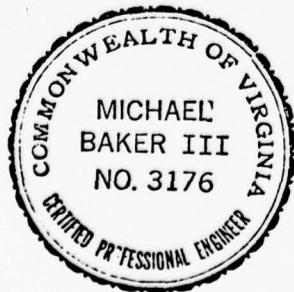
Original signed by:

Douglas L. Haller

Michael Baker, III, P.E.
Chairman of the Board and
Chief Executive Officer

Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Date: AUG 6 1978



NAME OF DAM: CARROLL

OVERALL VIEW OF DAM



OVERALL VIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: CARROLL ID# VA 17102

SECTION 1 - PROJECT INFORMATION

1.1 General

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.2.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

1.2.1 Description of Dam and Appurtenances: Carroll Dam is an earth fill dam with a crest height of 71 feet, a crest length of 601 feet and a crest width of 20 feet. The dam has two and one-half horizontal to one vertical (2.5:1) slopes. The slope on the upstream side below normal pool is 3:1. The emergency spillway is an earth, side channel type with a bottom width of 100 feet. The principal spillway is a two-way, standard open concrete riser with a 30 inch prestressed concrete pipe for a conduit. The reservoir is not used for water supply and there are no intakes below the riser crest elevation of 1284.0. A crank operated lift gate has been installed on the upstream side of the riser to lower the lake level if necessary. A plan and typical sections of the dam are shown on Plates 1 and 2.

1.2.2 Location: Carroll Dam is located on Alum Creek about 400 feet upstream of its confluence with Stony Creek. The dam is located about four miles upstream of the Town of Jerome,

NAME OF DAM: CARROLL

Virginia in Shenandoah County. A private airport is located immediately downstream of the dam. Regional and vicinity maps are included in this report as the Location Plan.

- 1.2.3 Size Classification: The dam classifies as an "intermediate" size based on its height and storage capacity.
- 1.2.4 Hazard Classification: Carroll Dam was given a "high" hazard classification in accordance with guidelines contained within Section 2.1.2 of the Recommended Guidelines for Safety Inspection of Dams because of its close proximity to commercial (the airport) and summer residential development of Bryce Mountain. The hazard classification used to categorize dams is a function of location only and has nothing to do with its stability or probability of failure.
- 1.2.5 Ownership: The dam is owned by Colonel C. C. Hamm.
- 1.2.6 Purpose of Dam: The dam is a multipurpose recreation and flood control structure.
- 1.2.7 Design and Construction History: The subsurface investigation for Carroll Dam was conducted in 1969. The dam was designed and constructed in 1971. The design was done by the U.S. Soil Conservation Service (S.C.S.). The dam was constructed by Robert A. Smith Construction Company. Yearly inspections are made by the S.C.S. Copies of recent inspections are on file at the Norfolk District, Army Corps of Engineers and enclosed in this report as Appendix V.
- 1.2.8 Normal Operational Procedures: No formal operating procedures are followed on this dam. Normal pool is controlled by the riser crest elevation of 1284.0 feet. Excess flows are diverted through the side channel emergency spillway. It is not known how often the lift gate for the 30 inch outlet conduit has been operated.

NAME OF DAM: CARROLL

1.3 Pertinent Data

1.3.1 Drainage Area: 4.6 square miles

1.3.2 Discharge at Dam Site: The maximum flood at the dam site is not known, but a high water mark at elevation 1304 was observed.

Principal Spillway:

Pool Level at emergency
spillway crest 130 c.f.s.
Pool Level at top of dam 147 c.f.s.

Emergency Spillway:

Pool Level at top of dam 17,581 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown on the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet M.S.L.	Area acres	Acre- feet	Reservoir Capacity	
				Watershed inches	Length feet
Top of dam	1327.6	75.3	1910	7.7	5280
Maximum pool, design surcharge	1317.8	54.8	1270	5.1	4435
Emergency spillway crest	1312.2	46.5	970	3.9	3960
Principal spillway crest (b)	1284.0	15	170	0.7	2006
Streambed at centerline of dam	1250.0	0	0	0	0

(a) Includes 170 acre-feet for 100 year sediment.

(b) Top of conservation pool and bottom of flood control pool.

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SECTION 2 - ENGINEERING DATA

2.1 Design: All available design data were furnished by the S.C.S. who designed the dam. The design data reviewed included the following:

- 1) The subsurface investigation original design drawings (as-built drawings).
- 2) Hydrologic and hydraulic calculations.
- 3) Soils and Geologic Reports (Geologic Report included in Appendix VI).
- 4) Stability Analyses (Appendix VII).
- 5) Laboratory soil test results.
- 6) Work Plan.

A description of design and other engineering data is included in Appendix IV. All data has been submitted to the Norfolk District for future reference.

2.2 Construction: The dam was constructed by Robert A. Smith Construction Company in 1971. No construction records were available for this inspection but are on file at the S.C.S. State Office in Richmond, Virginia.

2.3 Operation: There are no formal operating procedures for this dam; therefore, the slide gate used to drain the reservoir is not periodically operated. The Lord Fairfax Soil and Water Conservation District is responsible for all operation, annual inspections and maintenance including: liming, fertilizing and mowing of the embankment and spillways; the seeding and mulching of bare areas; painting the trash racks; and repairing gullies that occur in the dam and spillway areas. Annual inspections reports obtained from the District Conservationist of the Lord Fairfax Soil and Water Conservation District are included in Appendix V.

2.4 Evaluation

2.4.1 Design: The stability analyses do not represent as-built conditions. Foundation conditions were determined using the soils and geologic reports. The hydrologic and hydraulic data provided was adequate for design review.

NAME OF DAM: CARROLL

2.4.2 Construction: No construction records were available. However, the as-built drawings indicate modifications and changes made during construction.

2.4.3 Operation: Operation of the slide gate should be included as part of the annual maintenance program.

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SECTION 3 - VISUAL INSPECTION

3.1 Findings

3.1.1 General: The inspection was made on 2 June 1978. No unusual weather conditions were experienced, and the lake was at normal pool. The dam and appurtenant structures were found to be in good overall condition at the time of inspection. The problems noted during the visual inspection are considered minor and do not require immediate remedial treatment.

3.1.2 Dam: A twelve inch by six inch deep erosion gully was observed at the contact of the downstream embankment slope with the left abutment. A heavy growth of grass surrounded the gully which was about 30 feet in length. Additional measures will be needed to arrest the erosion. The channel is shown in Photo 1 of Appendix II.

A one foot high wave cut bench was observed on the upstream slope at normal pool elevation and is visible in Photo 2. The wave erosion did not appear to be progressive; and considering the large distance between the dam crest and normal pool (43.6 feet), riprap protection does not appear to be necessary. Upstream slope protection should be considered, if wave erosion does increase.

No seepage was observed on the embankment, below the top of the embankment, or through the abutments. Water was not flowing from the subdrain pipe outlets.

3.1.3 Appurtenant Structures: At the time of the inspection, the riser crest contained a great deal of lodged debris as shown in Photos 3 and 4. It is understood that the Lord Fairfax Soil and Water Conservation District maintains the riser and is responsible for clearing the trash racks. This cleanout should be done in the near future.

A two to three feet deep erosion channel has formed on the left slope of the emergency spillway. Although the erosion and debris the erosion channel leaves in the spillway channel should not affect the function of the structure; good maintenance practice requires that the erosion be repaired and any debris be removed.

NAME OF DAM: CARROLL

3.1.4 Reservoir Area: No serious deficiencies were observed in the reservoir area.

3.1.5 Downstream Channel: The outlet channels for the principal and emergency spillways showed no serious signs of past erosion. The riprap lining of the outlet channel extends for about 30 feet downstream.

3.2 Evaluation: None of the above items, with the exception of the debris in the riser trash rack, is serious enough to warrant immediate repair since they do not intrinsically threaten the integrity of the dam. However, these repair items are considered good maintenance practices and should be accomplished as part of an annual maintenance program.

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SECTION 4 - OPERATIONAL PROCEDURES

- 4.1 Procedures: No formal operational procedures are used on Carroll Dam since it is a recreational and flood control structure and does not require the use of water supply intake valves or gates.
- 4.2 Maintenance of Dam: The Lord Fairfax Soil and Water Conservation District has a yearly maintenance program in conjunction with an annual inspection by the S.C.S. District Conservationist. The District is responsible for liming, fertilizing and mowing of the embankment and spillways; the seeding and mulching of bare areas; painting the trash racks; and repairing gullies. Erosion has been detected and corrected at various times since the dam was built. Inspection Reports are included in Appendix V.
- 4.3 Maintenance of Operating Facilities: The Lord Fairfax Soil and Water Conservation District is responsible for the maintenance of the riser and lift gate. The crank which operates the gate appears to be in good condition.
- 4.4 Warning System: At the present time, there is no warning system or evacuation plan in operation.
- 4.5 Evaluation: Maintenance of the operating facilities are considered adequate for the functions that they serve. However, formal records of lift gate checks similar to the annual inspection reports should be instituted, perhaps as part of the annual inspections.

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SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

5.1 Design: The elevation of the crest (elevation 1284.0) of the drop inlet to the principal spillway was established at an elevation which would provide the conservation storage needed for sediment deposit and water supply. The capacity (130 c.f.s. with reservoir level at crest of emergency spillway) of the principal spillway was established by consideration of a number of factors including:

- 1) The capability of evacuating the flood storage space within a reasonable time (± 10 days).
- 2) Not passing damaging flows downstream.
- 3) The capability of the reservoir to store the flood waters.

The crest (elevation 1312.2) of the emergency spillway was established at the maximum elevation reached in routing the principal spillway hydrograph which resulted from the 100 year, 10 day rainstorm. The elevation of the top of the dam (elevation 1327.6) was established by the maximum elevation reached in passing the freeboard hydrograph. The freeboard hydrograph is that computed from rainfall comparable to the Probable Maximum Precipitation (P.M.P.) as used by the Corps of Engineers and is therefore comparable to the Probable Maximum Flood (P.M.F.)

5.2 Hydrologic Records: None

5.3 Flood Experience: No records of the lake levels were available. High water marks on the upstream slopes indicate that the water level has risen approximately 20 feet above normal pool. No flood discharge records were made to develop the S.C.S. Work Plan.

5.4 Flood Potential: Design features of the dam were established by routing various hydrographs as noted in paragraph 5.1.

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1, paragraph 1.3.3.

Regulation of flow from the reservoir is automatic. Water rising above the crest of the drop inlet flows into this inlet and through the dam in the 30 inch concrete conduit. Water also flows past the dam over the ungated emergency spillway in the event water in the reservoir rises over the crest of the spillway.

NAME OF DAM: CARROLL

Outlet discharge capacity reservoir area and storage capacity and hydrograph and routing determinations were obtained from reports and computations furnished by the S.C.S. The routing of the emergency spillway and freeboard hydrographs began with the reservoir level at the crest of the principal spillway.

5.6 Overtopping Potential: The probable rise in the reservoir and other pertinent information on reservoir performance in various hydrographs is shown in the following table:

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal	Hydrograph		
		Principal Spillway (a)	Emergency Spillway	Free- Board (b)
Peak flow, c.f.s.				
Inflow	---	---	6903	21,370
Outflow	---	130.5	3635	17,581
Peak elev., ft.M.S.L.	1284.0	1312.2	1317.8	1327.6
Emergency Spillway				
Depth of flow, ft.	---	---	5.6	15.4
Avg. velocity, f.p.s.	---	---	11.4	---
Non-overflow section				
Depth of flow, ft.	---	---	---	---
Avg. velocity, f.p.s.	---	---	---	---
Tailwater elev., ft.M.S.L.	--	---	---	---

(a) 100 year, 10 day volume produces the most conservatively large indication of flood control storage required. Detailed discharge hydrograph was not determined.
 (b) One-half P.M.F. by C.O.E. standards.

5.7 Reservoir Emptying Potential: The 30 inch gate on the upstream side of the riser at elevation 1259.0 will permit withdrawal of about 112 c.f.s. with the reservoir level at the spillway crest and essentially dewater the reservoir in about 24 hours.

5.8 Evaluation: Hydrologic and hydraulic determinations of the project as prepared by the S.C.S. appear reasonable. The dam and spillway are designed to pass a flood essentially equal to the P.M.F., which would be developed under standards used by the Corps of Engineers. The project would pass the P.M.F. without overtopping the dam.

It should be indicated that conclusions pertain to present day conditions, and that the effect of future development on the hydrology has not been considered.

NAME OF DAM: CARROLL

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The foundation of the dam at the centerline consists of three to thirteen feet of coarse grained alluvium over shale and sandstone bedrock. Colluvium covers the lower valley slopes. The cut-off trench provided for seepage control extends to the unweathered bedrock.

According to the test borings, the abutments are predominantly shale. High in the left abutment, about two to eight feet of residual soil covers the shale. About five to seven feet of colluvial soil at the base of this abutment overlies three to eight feet of the alluvium. The shale exposed in the emergency spillway strikes N.35°E. and dips 28°SE. The right abutment is steeper and has less soil cover.

6.2 Stability Analysis

6.2.1 Visual Observations: No evidence of instability in the embankment slopes, spillway cut slopes or concrete structures was observed. No seepage was observed in the embankment, abutments or foundation that would suggest an unstable condition. High water marks on the upstream slope show that the lake level has been approximately 20 feet above normal pool with no serious damage.

6.2.2 Design Data: Slope stability was checked by both the Sliding Wedge Method and a modification of the Swedish Circle Method. A Sliding Wedge Analysis was used because of the possibility of a shallow foundation failure. The zoned embankment section chosen for these analyses showed the shell of the dam adjacent to an impervious core with slope ratios of 1:1. Side slopes of the dam were shown as 2.5:1 over 3:1 on the upstream side and 2.5:1 on the downstream side. The following shear strength parameters were assumed for the foundation and embankment soils:

core $\phi = 13.5^\circ$, $c = 650$ p.s.f.
shell $\phi = 18.5^\circ$, $c = 525$ p.s.f.
foundation . . . $\phi = 35^\circ$, $c = 0$

The shear strength of the embankment soils were determined from consolidated undrained triaxial shear tests.

Minimum safety factors computed were 1.34 for the upstream slope under full drawdown and 1.52 for the downstream slope.

However, as-built conditions are different than the embankment section used for stability analyses. The as-built zoning is shown on Plate 4.

- 6.2.3 Operating Records: The yearly inspections indicate no deteriorating conditions beyond minor surface erosion.
- 6.2.4 Post-Construction Changes: No alterations of the dam were apparent since it was constructed.
- 6.2.5 Seismic Stability: Carroll Dam is located in Seismic Zone 2 and is considered to have no hazard of earthquakes according to the Recommended Guidelines for Safety Inspection of Dams.
- 6.3 Evaluation: The embankment section chosen for these stability analyses is not compatible with the as-built conditions. The core section configuration had been changed during construction, and transition zones were added. These changes may affect the factor of safety for slope stability. Therefore, additional stability analyses using as-built sections are recommended.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The dam is designed to prevent overtopping under conditions during the P.M.F. No seepage or slope failures were noted that would indicate potential piping or embankment failure. Although some minor erosion exists, major erosion problems are not present.

The data available were sufficient to evaluate the adequacy of design. As-built drawings and visual inspection indicated no serious departure from design conditions.

The dam will not require urgent remedial treatment. No additional investigations are necessary at this time.

7.2 Recommended Remedial Measures: Repair of erosion on the downstream slope of the dam and the left slope of the spillway will be necessary. The riser inlet and trash rack should be cleaned of debris and continued to be cleaned frequently in the future. In addition, a staff gauge should be installed on the riser to monitor reservoir elevations above normal pool. These items can be accomplished through the Lord Fairfax Soil and Water Conservation District's annual maintenance program. It is also recommended that the grass on the embankment and abutment be cut before the annual maintenance inspection. Wave erosion on the upstream slope should be checked yearly to determine if the erosion has progressed to a limit that would require riprap protection. It is also recommended that stability analyses be performed using the as-built embankment section.

APPENDIX I

PLATES

CONTENTS

Location Plan

Plate 1: Plan of Dam

Plate 2: Typical Section Through Dam

Plate 3: Riser Details

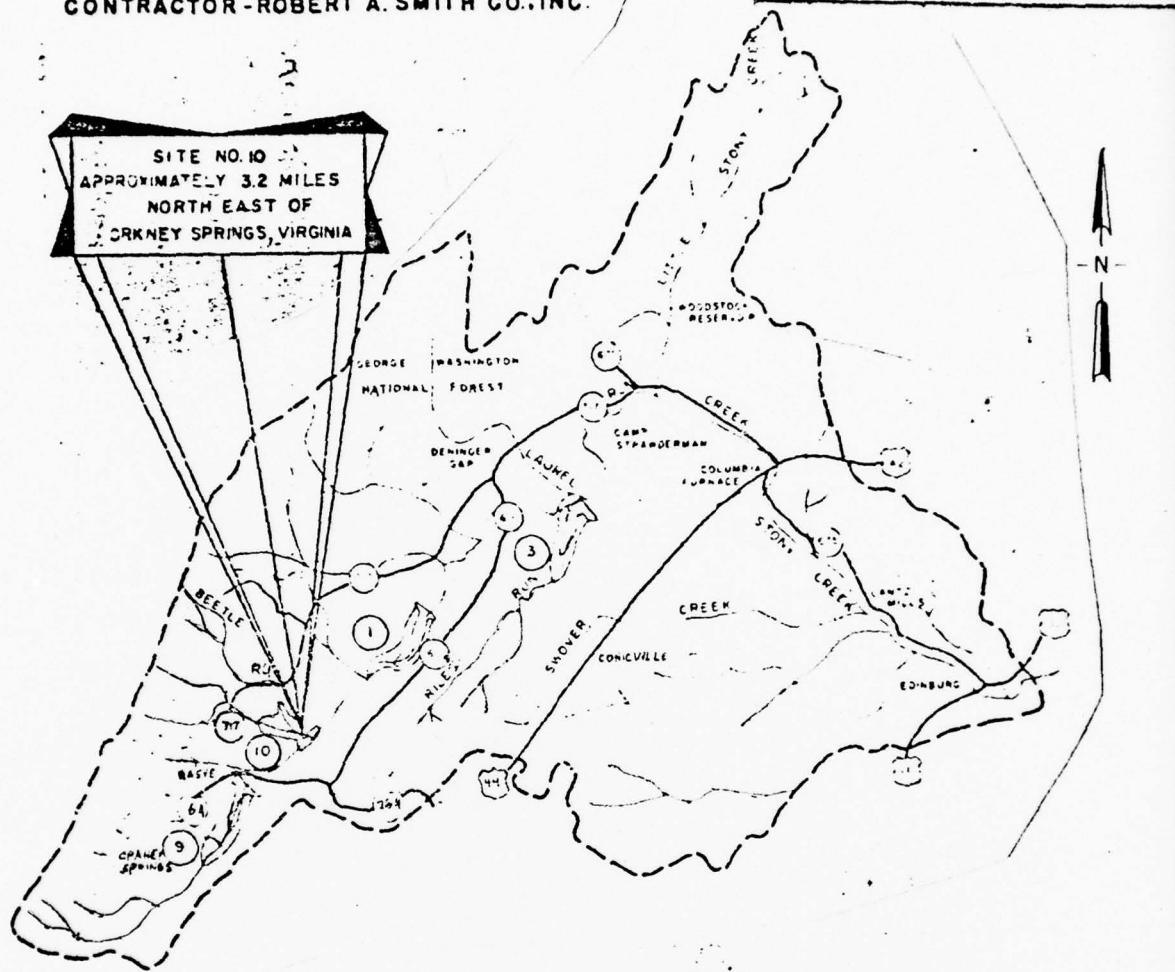
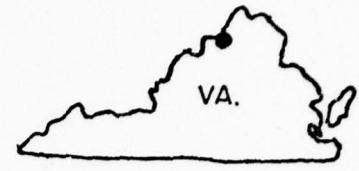
Plate 4: Embankment Sections

Plate 5: Borrow Area Locations

NAME OF DAM: CARROLL

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CONTRACTOR - ROBERT A. SMITH CO., INC.



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AS BUILT

STONY CREEK SITE NO. 10
STONY CREEK WATERSHED
SHENANDOAH COUNTY, VA.
COVER SHEET

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

R.W. WILSON DRAFTED C.H. HOBBS TYPED Drawing No. 100-1000-1000	DATE 2/71 JULY Drawing No. 100-1000-1000	STATE CONSERVATION C.M.
R.L. HYATT DRAWN C.H. HOBBS TYPED Drawing No. 100-1000-1000	2/71 2/23 Drawing No. 100-1000-1000	VA-589-P

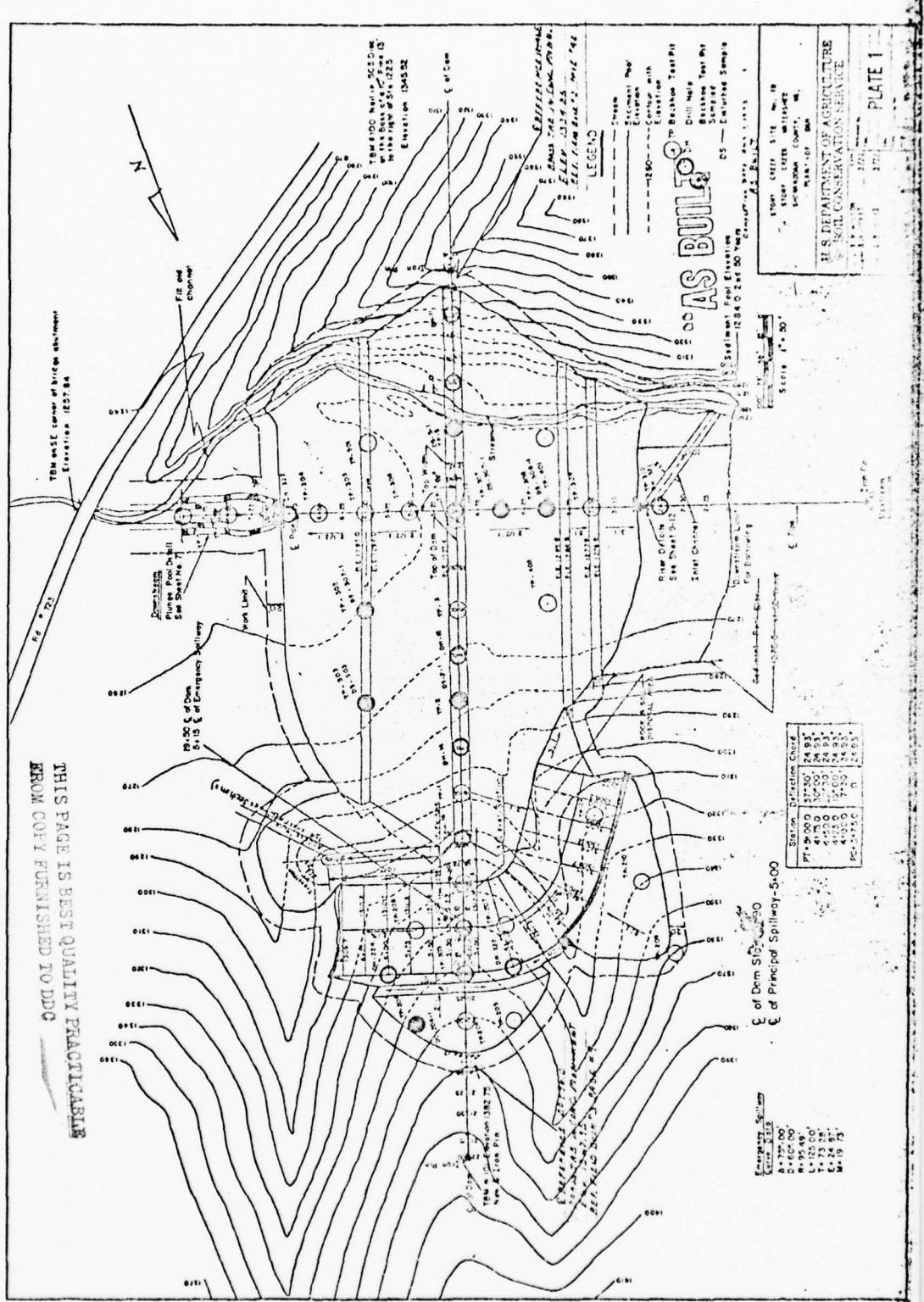
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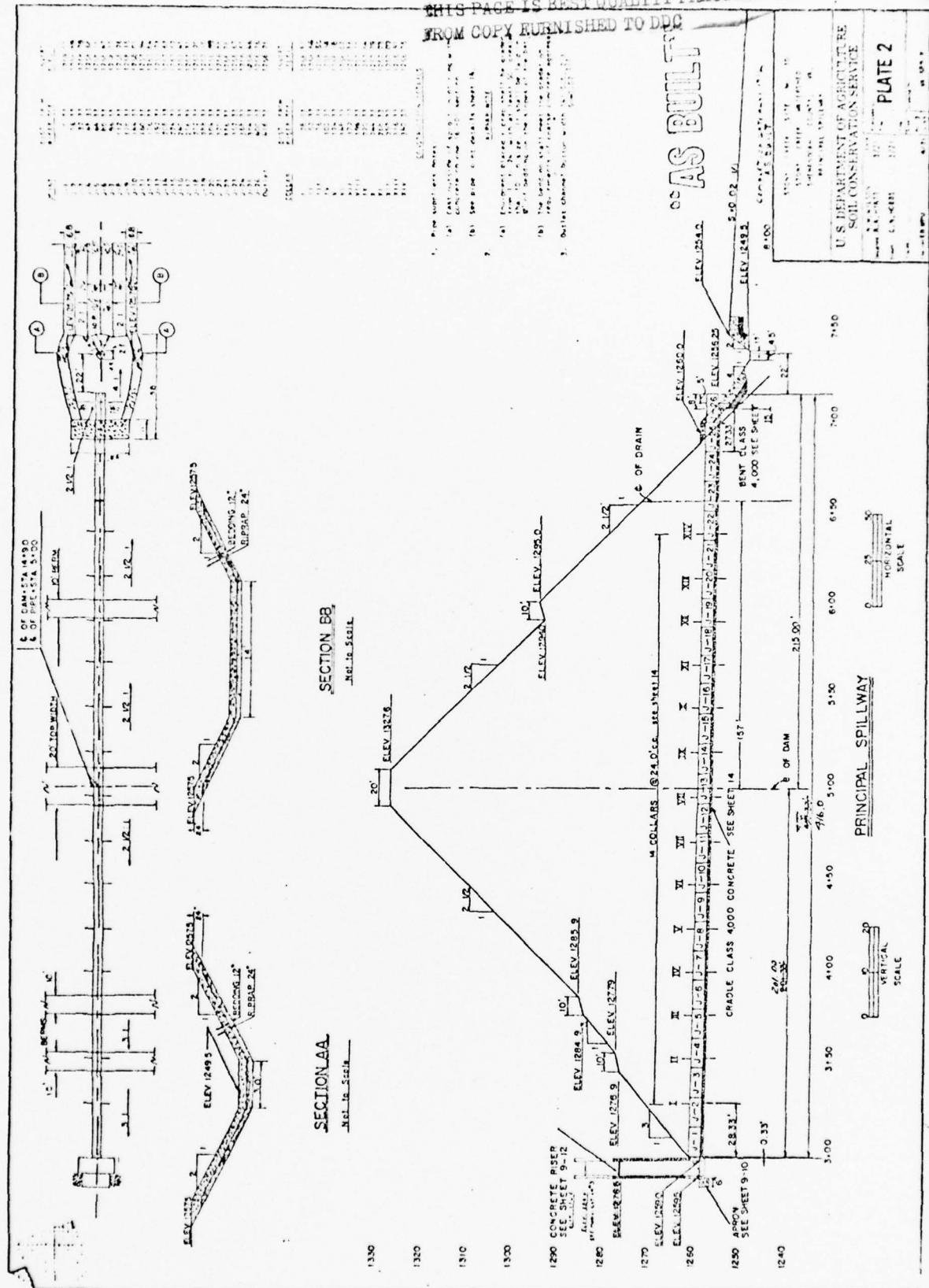
SCALE

LOCATION PLAN
CARROLL

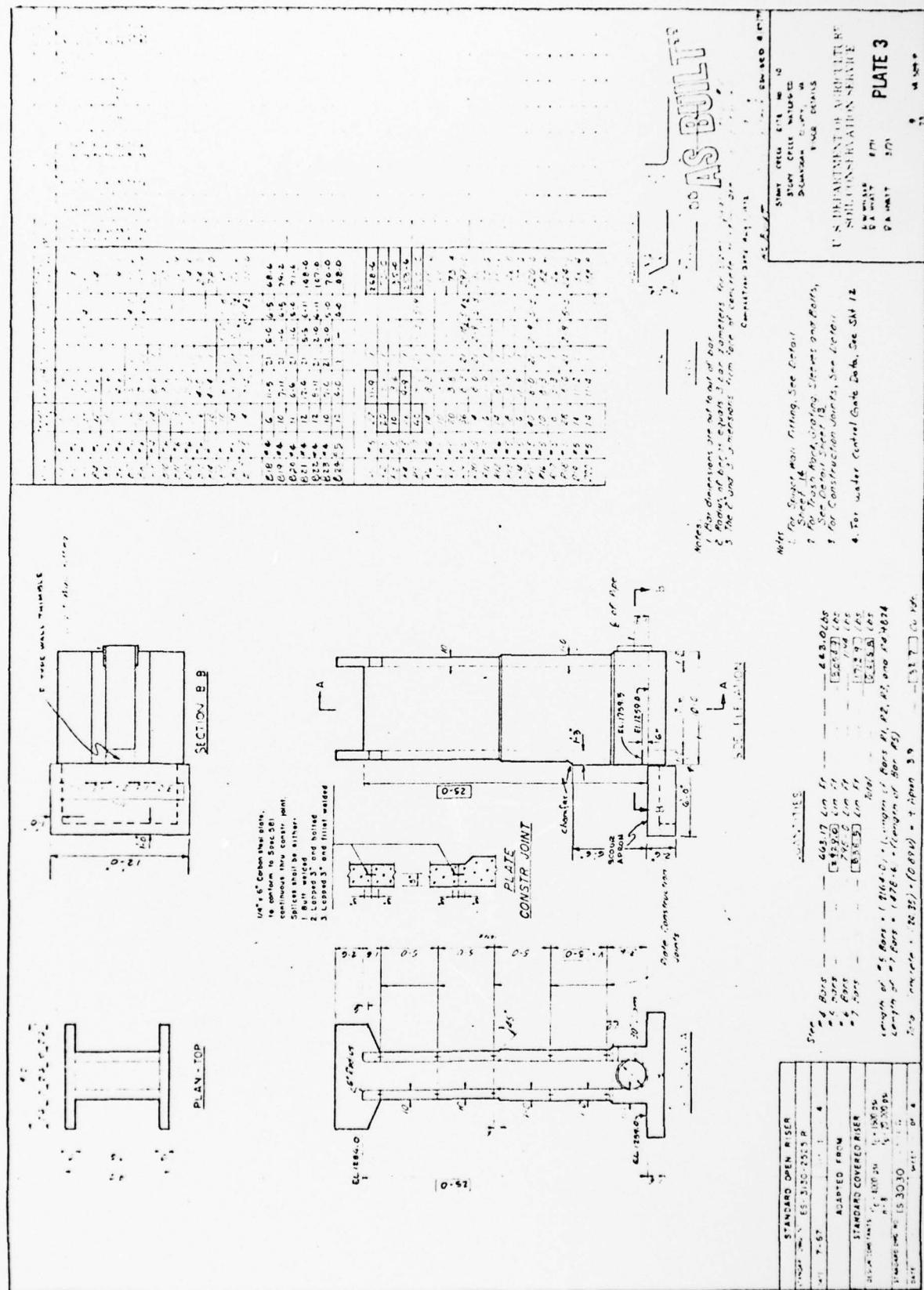
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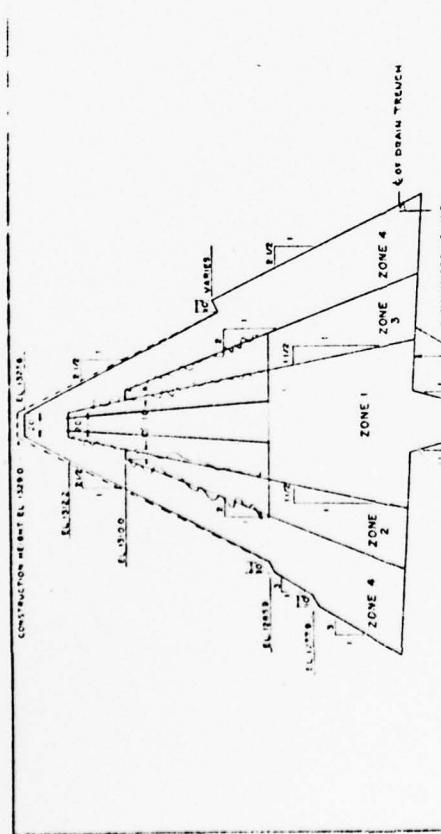


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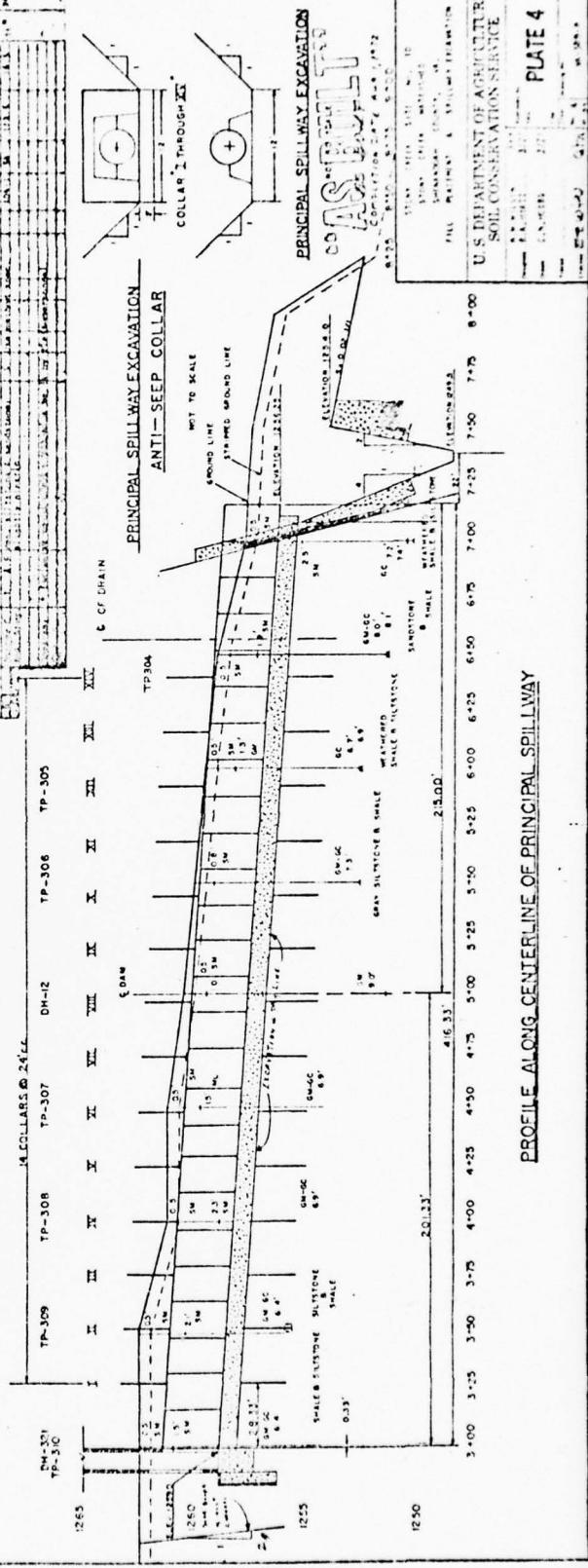
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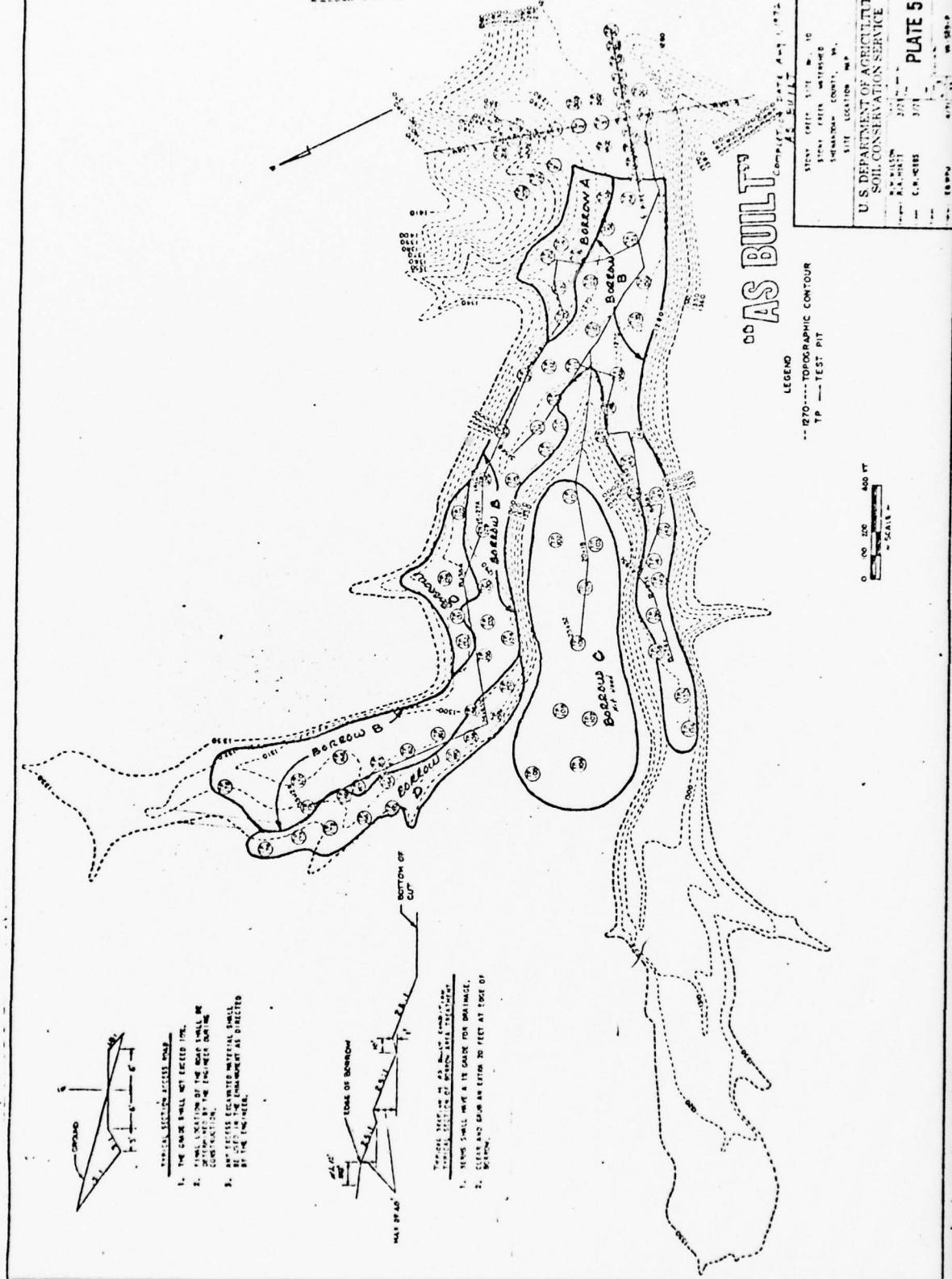
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LEGEND

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APPENDIX II

PHOTOGRAPHS

CONTENTS

Photo 1: Gully Erosion at Intersection of Downstream Slope and Left Abutment

Photo 2: Wave Eroded Bench at Normal Pool on Upstream Embankment Slope

Photo 3: Riser with Debris Lodged in Trash Rack, Crest and Grate

Photo 4: Closer View of Debris in the Riser

Note: Photographs were taken 2 June 1978.

NAME OF DAM: CARROLL



PHOTO 1

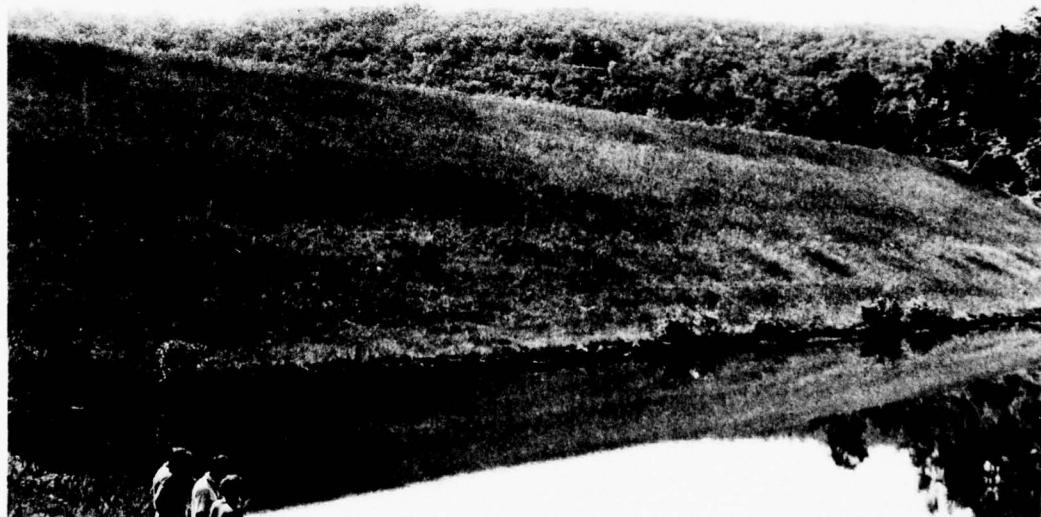


PHOTO 2



PHOTO 3



PHOTO 4

APPENDIX III

CHECK LIST - VISUAL INSPECTION

Check List
Visual Inspection
Phase 1

Name	Dam	Carroll	County	Shenandoah	State	Virginia	Lat.	3849.0°
(Stony Creek No. 10)						Coordinates Long. 7846.3°		

Date Inspection 2 June 1978 Weather Sunny Temperature 80° F.

Pool Elevation at Time of Inspection 1284.0 M.S.L. Tailwater at Time of Inspection 1255.0 M.S.L.

III-1

Inspection Personnel:

MICHAEL BAKER, JR., INC.:

J. Dziubek
D. J. Greenwood
J. Thompson

VIRGINIA WATER CONTROL BOARD:

Tom Mizej
Ken Hinkle
J. Dziubek
Recorder

Carroll

EMBANKMENT

Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	No surface cracks were observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No bulges or apparent earth movements were observed.	
SLoughing OR Erosion OF EMBANKMENT AND ABUTMENT SLOPES	Erosion is present at the embankment-left abutment contact. The erosion channel is approximately 12 inches wide by six inches deep. No slough was observed.	Erosion channels should be filled and reseeded. Paved gutters may be needed in the future.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Crest alignment is good. No bulging or bowing was observed.	
RIPRAP FAILURES	No riprap was designed or placed on the upstream slope. A small wave cut bench with a one foot scarp has formed at normal pool.	Although the slope below normal pool is 3:1 (10:1 for a bench at normal pool), riprap should be placed as erosion becomes progressive.

EMBANKMENT

Carroll

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No tension cracks were observed but a small erosion channel had formed at the embankment left abutment contact.	The erosion channel should be filled and reseeded. Paved gutters may be needed if erosion is not arrested.
ANY NOTICEABLE SEEPAGE	No seepage was observed; not even at the right abutment where rock outcrops are exposed upstream and downstream of the embankment and a seepage path would be more likely to develop.	
STAFF GAGE AND RECORDER	None were observed.	
DRAINS	Toe drain with eight inch diameter C.M.P. was installed in drainage trench. Outlets for the drain were not flowing at the time of inspection.	
FOUNDATION	Shale and sandstone according to the test borings and test pits. Shale in emergency spillway cut has strike of N 35° E and dips 28° SE.	

OUTLET WORKS		REMARKS OR RECOMMENDATIONS
VISUAL EXAMINATION OF	OBSERVATIONS	
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None was observed. The prestressed concrete is in good shape.	
INTAKE STRUCTURE	Two-way covered riser is in good condition. The structure was checked with a plumbbob and is not leaning. No cracking was observed. Intake was partially obstructed by debris.	Logs and tree branches are partially obstructing the riser crest and should be removed as soon as possible.
OUTLET STRUCTURE	Thirty inch concrete pipe and two (2) eight inch C.M.P. drains. There are no head walls.	
OUTLET CHANNEL	Limestone riprap extends for about 30 feet downstream; but, plans call for approximately 90 feet. This item should be considered to prevent further erosion. Downstream channel has good growth and vegetation and is regular in shape.	Re-examine hydraulics of channel and line additional channel length if necessary with riprap.
EMERGENCY GATE	Thirty inch diameter gate with hand operated crank. Elevation of invert 1259.0 feet. Gate will drain entire lake. No evidence of rusting.	Gate should be opened periodically.

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UNGATED SPILLWAY

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CONCRETE WEIR	There is none (the dam has an earth side channel spillway).	
APPROACH CHANNEL	Slopes were repaired for erosion from runoff above cut.	
III-5		
DISCHARGE CHANNEL	Some erosion exists on slope on left side of the outlet end of the spillway.	Erosion should be repaired. Eroded soil should be removed from spillway channel before the debris becomes a serious obstruction.
BRIDGE AND PIERS		Not Applicable

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INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	A concrete monument and iron pin were noted on the right and left abutments coincident with the dam centerline.	
OBSERVATION WELLS	No wells were noted.	
WEIRS	None	
PIEZOMETERS	None were observed.	
OTHER		

RESERVOIR

Carroll

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
SLOPES	Nearly 100 percent slope at reservoir level on right abutment. Exposed rock face occurs here due to former stream channel location. Left abutment slopes are about 25 percent to 30 percent. The slopes are wooded.	
SEDIMENTATION	No sedimentation studies were initiated to date.	

DOWNSTREAM CHANNEL

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Downstream channel is regular in cross section. The over-growth should be removed or thinned out regularly. The channel could use more riprap extended further down from the outlet.	
SLOPES	The area is relatively flat below the dam to Stony Creek. The stream channel slopes two percent.	
APPROXIMATE NO. OF HOMES AND POPULATION	An airport runway and a ski lodge are located one-half mile downstream. Five dwellings are located within one mile of the dam. Jerome with a population of 10, is the nearest downstream town.	

APPENDIX IV

CHECK LIST - ENGINEERING DATA

Carroll

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

<u>ITEM</u>	<u>REMARKS</u>
PLAN OF DAM	A complete set of as-built plans are available at the Norfolk District of the Corps of Engineers. A plan view of the dam is included in this report as Plate 1.
REGIONAL VICINITY MAP	The Location Plan is attached.
CONSTRUCTION HISTORY	The foundation investigation was done in 1969. The dam was designed by the S.C.S. in 1971 and constructed by Robert A. Smith Construction Co. in the same year.
TYPICAL SECTIONS OF DAM	Typical sections of the dam are enclosed in the Phase I Construction Report as Plate 5.
HYDROLOGIC/HYDRAULIC DATA	Obtained from S.C.S. via the A.C.E.
OUTLETS - PLAN and	
- DETAILS	are available at the Norfolk District.
- CONSTRAINTS	
- DISCHARGE RATINGS	are included in the S.C.S. design calculations and are available at the Norfolk District
RAINFALL/RESERVOIR RECORDS	No rainfall or reservoir level records are available at the dam. Rainfall data is available from Virginia Climatological Records.

ITEM	REMARKS
DESIGN REPORTS	Design calculations by the S.C.S. are available at the Norfolk District. No contract specifications were available.
GEOLOGY REPORTS	A subsurface investigation consisting of test pits and test borings are part of the design documents. No formal geology reports were available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Design computations were done by the S.C.S. for hydrology and hydraulics. No stability or seepage calculations were available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	A foundation and borrow investigation was performed with test borings and test pits. Constant head borehole permeability tests and pressure testing was done with the borings.
POST-CONSTRUCTION SURVEYS OF DAM	The dam is inspected yearly by the S.C.S. district conservationist. Copies of these inspection reports are attached to this report.
BORROW SOURCES	The as-built drawings show the borrow sources as follows: Borrow A: Upstream left abutment Borrow B: Reservoir area Borrow C: Peninsula area between the two legs of the reservoir and along north shoreline Borrow D: West shoreline of the north leg of the reservoir

Carroll

<u>ITEM</u>	<u>REMARKS</u>
MONITORING SYSTEMS	No monitoring systems other than the spillway riser were designed into the dam.
MODIFICATIONS	No known modifications have been made other than repairing erosion and reseeding.
HIGH POOL RECORDS	No high water records are available.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Yearly inspections are made by the District Conservationist of the S.C.S. No known major construction has been done since the dam was built.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	There were none.
MAINTENANCE OPERATION RECORDS	Yearly inspections are made by the S.C.S. Erosion repair and reseeding have been done.

ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS	The section measured in field closely matches that on plans, (i.e., 100 feet wide and approximately the same slopes).
DETAILS	Earth with minimal growth. Slight erosion was noted from hillside drainage. Plans and details are available at the S.C.S. Richmond Office.

OPERATING EQUIPMENT Crank operated lift with pedestal base was used. Plans and details are available at the S.C.S. Richmond Office.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 2,964 acres or approximately 4.6 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1284.0 M.S.L.

1312.2 M.S.L.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): (800 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: 1317.8 M.S.L.

ELEVATION TOP DAM: 1327.6 M.S.L.

CREST: Emergency spillway

a. Elevation 1312.2 M.S.L.

b. Type Earth side channel

c. Width 100 feet

d. Length 375 feet

e. Location Spillover Left side of dam

f. Number and Type of Gates One side gate for drain

OUTLET WORKS:

a. Type 30 inch concrete pipe

b. Location Right of center of dam

c. Entrance inverts Inlet tower normal pool 1276.5 M.S.L.

d. Exit inverts 1256.25 M.S.L.

e. Emergency draindown facilities Yes, 30 inch slide gate (elevation 1260.75 M.S.L.)

HYDROMETEOROLOGICAL GAGES: None

a. Type

b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE Unknown

Carroll

APPENDIX V

ANNUAL MAINTENANCE INSPECTION REPORTS

LORD FAIRFAX SOIL AND WATER CONSERVATION DISTRICT
REPORT OF ANNUAL MAINTENANCE INSPECTION OF WATERSHED DAMS
STONEY CREEK WATERSHED PROGRAM

APRIL 8, 1977

The inspection was made after the Lord Fairfax S&WCD monthly meeting. Most of the District Directors were on hand for the inspection.

Dam No. 9 There is an adequate vegetative cover on the dam and spillway. No erosion was noted. The grass cover was limed and fertilized in 1976. However, due to extremely dry weather, the grass has not had a chance to respond to this treatment.

Dam No. 10 The dam, spillway, etc., are in good condition with good vegetative cover.

C. E. Hofer

C.E. Hofer, Chairman
Lord Fairfax S&WCD

Gerald E. Richardson

Ronald E. Richardson, L.C.
Soil Conservation Service

LIST: SCS Harrisonburg Area Office
SCS Woodstock Field Office
Lord Fairfax S&WCD

P. O. Box 390, Woodstock, Virginia 22664
June 30, 1976

Report of Inspection at Dam No. 9

The stand of Ky 31 fescue is well established. However, the growth is not as dense as it should be due to acid soil. In addition, some potential erosion problems exist due to traffic on the face of the dam. The three eroded drainways on the east side of the lake have begun to heal over.

It is recommended that:

- 1) Mowing frequency be kept to a minimum;
- 2) 1 ton of agricultural ground limestone per acre be applied to the dam and spillway area;
- 3) A soil sample be taken every year, and that lime and fertilizer be applied according to the test results.

Edward M. Conklin, Director
Lord Fairfax Soil & Water Conservation District

Ronald E. Richardson, District Conservationist
Soil Conservation Service

Kenneth C. Brill, Technician
Soil Conservation Service

COMMONWEALTH OF VIRGINIA



LORD FAIRFAX SOIL AND WATER CONSERVATION DISTRICT

REPORT OF ANNUAL MAINTENANCE INSPECTION OF WATERSHED DAMS
STONY CREEK WATERSHED PROGRAM

APRIL 29, 1975

Dam No. 9 - The stand of Ky. 31 Fescue is well established. However, the growth is not as dense as should be due to excessive mowing and lack of plant nutrients. In addition, some erosion problems exist due to traffic on the face of the dam. Three (3) drainways on the east side of the lake are showing signs of active erosion where they enter the lake.

It is recommended that:

- ✓ (1) Mowing frequency should be kept to a minimum, in any event no shorter than 4" - 6".
- ✓ (2) 600 lbs. per acre of 5-10-10 fertilizer (or equivalent) should be applied to the dam and spillway area. A soil sample should be taken every year and lime and fertilizer applied each fall in accordance with the test results;
- ✓ (3) All traffic should be excluded from the dam face;
- (4) The gullies in the drainways should be smoothed and lined with concrete or other masonry material. This material should extend from the normal water level to the top of the embankment at the old road.

✓ Dam No. 10 - The stand of Ky. 31 Fescue was well established and healthy with one exception. There is some active erosion at the spillway entrance, i.e. the west side of the dam. The erosion is caused by an accumulation of water from a small watershed above the dam draining through a section of the spillway entrance which failed to establish a good stand of grass cover. A small gully approximately 200 feet in length has formed and is outletting into the lake.

It is recommended that this area be repaired and reestablished in grass.

B. A. Hepner

B. A. Hepner, Director, Lord Fairfax
Soil and Water Conservation District

Ronald E. Richardson

Ronald E. Richardson, DC
Soil Conservation Service

E. M. Conklin

Edward M. Conklin, Director, Lord Fairfax
Soil and Water Conservation District

DIST: SCS State Office
SCS Area Office
SCS Woodstock Field Office
Lord Fairfax S&WCD
Bryce Mountain Resort

LORD FAIRFAX SOIL AND WATER CONSERVATION DISTRICT
REPORT OF ANNUAL MAINTENANCE INSPECTION OF WATERSHED DAMS
STONY CREEK WATERSHED PROGRAM

DECEMBER 18, 1974

The inspection was made on December 4, 1974; conditions and recommendations are as follows:

Dam No. 9 The stand of Ky. 31 Fescue was well established. The current year's growth was stunted, however, due to the extremely dry weather during the fall growing season in conjunction with close mowing during this same time period.

It is recommended that mowing operations be terminated by about August 15 in order for the grass to establish a good winter mulch.

Dam No. 10 The stand of Ky. 31 Fescue was well established and healthy with one exception. There is some active erosion at the spillway entrance, i.e. the west side of the dam. The erosion is caused by an accumulation of water from a small watershed above the dam draining through a section of the spillway entrance which failed to establish a good stand of grass cover. A small gully approximately 200 feet in length has formed and is outletting into the lake.

It is recommended that this area be repaired and reestablished in grass.

B.A. Hepner
B.A. Hepner, Director, Lord Fairfax
Soil and Water Conservation District

Ronald E. Richardson
Ronald E. Richardson, DC
Soil Conservation Service

Kenneth C. Brill
Kenneth C. Brill, Conservation Tech.
Soil Conservation Service

DIST: SCS State Office
SCS Area Office
SCS Woodstock Field Office
Lord Fairfax S&WCD

APPENDIX VI

GEOLOGIC REPORT

12-65

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Virginia County Shenandoah ; 1/2, 1/2, Sec. 1, T 1 R 1 ; Watershed Stony Creek
Subwatershed Beetle Run Fund class (FP-2, WP-1, etc.) Site number 10 Site group 1 Structure class C
Investigated by Geologist Equipment used Acker Truck Drill Date 2/70
(signature and title) Mounted DRTT 1 mod (29°)
SITE DATA Front End Loader & Backhoe

Drainage area size 4.63 sq. mi. 2963 acres Type of structure Earth Fill Purpose Flood Prevention
Direction of valley trend (downstream) E Maximum height of fill 66.0 feet. Length of fill 600
Estimated volume of compacted fill required 203,500 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	<u>238</u>	<u>9</u>	<u>24</u>
Floodwater	<u>788</u>	<u>46</u>	<u>52</u>

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Valley and Ridge Topography Mountainous Attitude of base Dip N 37 1/2° E Strike 24° SE
Steepness of abutments: Left 20 percent; Right 75 percent. Width of floodplain at centerline of dam 200
General geology of site: Stony Creek Site #10 lies in southern Shenandoah County, about 17 miles southwest of Woodstock, Virginia. The site is on Beetle Run, a western tributary of Stony Creek, one mile north of the village of Basye.

The Chemung Formation of Upper Devonian age underlies the site. The rock consists of soft gray shale with stringers and lenses of light gray, fine arkosic sandstone. A few sandstone beds are as much as 20 feet thick but the geologic section is predominantly shale. The individual sandstone beds do not appear to extend far laterally (see sheet 2 of SCS - 35's).

Page 1

Four joint directions can be determined in the rock. Bedding plane joints account for most of those observed in the drilling cores. Other joint sets strike N 22.5° E, S 87.5° E, and N 30° E, with dips of 75°, 80°, and 90°, respectively.

This dam site is on the western limb of a shallow syncline. In the core of the syncline, east of the site, is exposed the Hampshire Formation (upper Devonian.) The Brallier Formation is exposed in the valley sides 800 feet or more upstream (west) of the centerline of the dam, and dips easterly under the Chemung Formation. The Brallier is a grayish-green shale.

In many places, the sandstone interbeds in the shale have random fractures filled with shale, or there is sandstone breccia in a shale matrix. This may have been caused by disturbance of the original sand and mud during deposition in the Appalachian miogeosyncline.

The stream pattern in this area is partly a trellis and partly a dendritic one. Relatively low dips are responsible for this pattern.

Alluvium consisting of cobbles and pebbles of sandstone and shale, with a silty sand or clayey matrix overlies weathered shale and sandstone in the valley bottom. Silty sand or sandy silt overlies the gravel in some places, and silty clay to clayey silt rests on the gravel in others. Shale colluvium covers the lower valley slopes as GM-GC material. Shallow residual soil (GM) with bedding preserved, mantles the valley sides elsewhere.

Methods and Procedure

1. Permeability was measured after each drill run (usually five feet) The K-factor is recorded in feet/day. It was calculated for NX core by the formula $K = C_p Q/h$. C_p is obtained for different lengths of test section of NX diameter from the table on page 545 of the Earth Manual. In permeability calculations in rock, subtract the Q value above a given test section from the total Q value including that section (below casing) to obtain the gpm value for that test section.

2. Pressure tests were taken, increasing and then decreasing pressure. This was to determine whether fractures opened or closed with increase of pressure. Closing of fractures was indicated by fall of permeability from the initial pressure after it was resumed. Siltling up of openings would cause such closing. The maximum pressure used was determined by the maximum psi exerted at the top of the hole by proposed impoundment water; however, applied psi in pressure tests was kept numerically less than the depth in feet to the top of the test section.

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in the formula $K = C_p Q/h$, h was interpreted as in cases above the water table if permeability tests or cores showed the rock to be tight.

3. The rock recovery and rock quality designation of each core run was recorded. Rock quality designation is the total length of all core pieces more than 4" long, separated by natural breaks (not those due to handling), divided by the length of the run and expressed as a percent.

4. The Unified Soil Classification System was used in description of soils. The USDA System was used in correlating borrow material.

Centerline of the Dam

Shale and interbedded fine sandstone of the Chemung Formation underlie the centerline of the dam. The rock color varies from dark gray in the shale to light gray with almost a pinkish hue in the sandstone. There are at least four units of sandstone in the shale that can be distinguished along the centerline of the dam. These sandstone units are from five to 20 feet thick. The zone of permeability extends from 35 to 40 feet below the top of rock (see sheet 8 of SCS-35's). Some isolated masses of impermeable rock (K factor less than 0.5 ft/day) are apparently surrounded by permeable rock, as in DH 15 and 16. The permeability of the rock is due to the jointing pattern described above (page 1). The dip of the strata averages 24° SE, toward the right abutment and downstream.

On the left abutment, colluvium of the Hayter Series, five to seven feet thick, extends from about Sta. 15+50 to 17+75. This material is silty to clayey gravel, red-brown, with angular shale and sandstone pebbles making up 70% of the soil. The colluvium covers alluvial gray clayey silt with brown mottles, 3.7-8.2 feet thick. At 16+00, 1.3 feet of alluvial red sandy silt lie between the colluvium and the clayey silt. Alluvial clayey gravel lies below this, 2.8 feet thick, becoming silty gravel to the right of Sta. 15+50, and thickening to 8 feet. Sandstone cobbles and pebbles, with some shale pebbles, make up 80% of the alluvial gravel.

Red-brown silty sand, 1.0-3.0 feet thick, overlies the gravel to the right of Sta. 15+00. Thin residual silty gravel extends from 17+75 to the top of the dam on the left abutment and from 13+40 to the top of the dam on the right. This residual GM also underlies parts of the alluvial gravel, from 13+75 to 14+50 and at 15+00.

K factors from permeability tests in the left abutment (left of Sta. 16+00) range from 0 to 12 ft/day, with most values under 2.5 ft/day. Pressure tests gave results ranging from 0 to 10.9 ft/day with almost

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K values below 5 ft/day. Beneath the floodplain, (13+40 to 16+00), K -values from permeability tests ranged from 0 to 19.6 ft/day, with most values below 7 ft/day. Pressure tests ranged from 0 to 10.6 ft/day with most values below 5 ft/day. In the right abutment, (DH-11) permeability ranged from 0 to 12.5 ft/day, or more. The hole could not be tested below 34 feet. Pressure tests ranged from .08 to 3.5 ft/day with most values below 1.0 ft/day. The rock could not be tested above 25 feet.

There is a discrepancy between water levels in test pits and those in drill holes along the centerline. This can be explained by the fact that the test pits were dug in October of 1969 when the water table was low and the drill holes made in February of 1970 when the water table was high from melt water runoff from snow and ice. Some artesian flow may have held the water levels higher in drill holes of the left abutment than they otherwise would be.

To investigate the centerline of the dam 5 test pits and 6 drill holes were made. They are numbered TP-1 to TP-5 and DH-11 to DH-16.

Principal Spillway

The proposed principal spillway crosses the centerline of the dam at 14+90 ¢ dam and 5+00 ¢ pipe. The two centerlines are at right angles. Alluvial GM or GC material similar to that under the ¢ dam underlies the pipe location. It ranges from 2.7 to 8.0 feet thick. 1.3 to 3.3 feet of red silty sand covers the gravel from Sta. 3+00 to 5+00 and from 6+00 to 8+00. Weathered shale (GM), 3.5 feet thick, underlies the gravel at 8+00. The rock line decreases somewhat unevenly from 1256 feet at the riser end to 1246 feet at Sta. 8+00.

Drill holes at the upper and lower ends of the pipe show an apparent sharp decrease of depth to impermeable rock toward the bent of the pipe. K values for the permeability tests ranged from 0 to 13.25 ft/day for the upper end of the pipe, with most values below 1 ft/day, although artesian counterflow may be responsible for some low permeability readings. Pressure tests showed a variation between .22 and 19.25 ft/day.

In the downstream portion of the pipe, permeability values ranged between 0 and 15 ft/day, with most values below 1 ft/day. Pressure tests yielded values from 0 to 5.2 ft/day with most values below .5 ft.

Ten test pits and two drill holes were dug to investigate the pipe. They are numbered TP 301-310 and DH 321 and DH 322.

Foundation

Foundation conditions are generally similar to those described under the centerline of the dam. Upstream the alluvial gravel is clayey toward the left side of the floodplain and sandy with silt toward the right. Red silty sand to sandy pebble gravel, 1.3 to 3.4 feet thick.

covers the gravel on the right half of the floodplain.

Downstream the gray and brown-mottled clayey silt or silty clay (see $\frac{1}{2}$ dam) extends over the gravel in the left half of the floodplain, and the silty sand covers the gravel to the right.

Five test pits were dug in the foundation. They are numbered TP 401-402 upstream and TP 501-503 downstream.

Emergency Spillway

The emergency spillway is located in the left abutment, in jointed shale and sandstone. The centerline of the spillway crosses the center line of the dam at 5+20 $\frac{1}{2}$ EMS and 19+50 $\frac{1}{2}$ dam. The two centerlines form an angle of 90°. Shallow residual soil (Muskingum Series) underlies the spillway area. It consists of silty gravel, from two to five feet thick, with shale bedding retained. There is little or no B-horizon.

The rock in the emergency spillway cut appears to be mostly shale. A sandstone bed at least 3.5 feet thick lies beneath the $\frac{1}{2}$ EMS at the $\frac{1}{2}$ dam at 18.0 feet.

Rock quality designation was 0 as deep as 14 to 20 feet below the surface. Below 14 to 20 feet, it ranged from 33.3% to 80.5%.

Eleven test pits and four drill holes were dug in the emergency spillway area. They are numbered TP 201-211 and DH 221-224.

Borrow Areas

The borrow areas extend upstream from the centerline of the dam as much as 3600 feet. They include principally low terrace alluvium and colluvium along Beetle Run and its tributary, Alum Run. Residual soil on shale, siltstone, and sandstone lie on adjacent upper hillslopes; residual soil, high terrace alluvium and colluvium lie on the ridge between Beetle Run and Alum Run. The thickness of the soil ranges from less than a foot in the residual material to over 10 feet in colluvium (see isopach map, SCS - 35's).

Borrow Area "A"

Colluvial deposits lie mostly along Beetle Run. The lower left slopes from the $\frac{1}{2}$ dam to 900 feet upstream contain colluvium (Hayter Series), mostly light gray silty clay and clayey silt with red-brown to yellow-red mottles, and from 4.5 to 8.5 feet thick. In one place this becomes clayey gravel 3.2 feet thick. Toward the upstream end of this colluvial area, the mottled CL-ML material is overlain by red-brown

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ravelly clay and silty shale-pebble gravel four feet thick. The mottled CL-ML is replaced at the upper end of this area by 6.25 feet of yellow-red SC or CL overlain by three feet of brown silty sand. Sandstone and siltstone underlie this colluvium. No water table was seen above bedrock at the time of investigation. Total borrow here is 25,000 yards. Test pits 118-121, 123, and 153 were dug in this area.

Borrow Area "B"

Farther upstream on the left side of Beetle Run from 1600 to 2400 feet from the Q dam, a colluvial slope is underlain by 5.5-9.0 feet of clay or silt, gray with brown mottles (Leadvale Series). This deposit contains occasional sandstone pebbles. 1.7 feet of light gray, silty sand underlie it in one place. No water table was found here. There is approximately 25,000 yards of borrow in this area. Test pits 127, 128, 131, and 132 were dug to investigate this area.

Borrow Area "C"

Borrow Area C is a colluvial area on the right side of Beetle Run, 1900-2700 feet upstream from the Q dam. The colluvium (Leadvale) includes clayey silt 4.0 to 5.7 feet thick, with pebbles and cobbles of sandstone and siltstone. This material is mottled red, brown, yellow, and gray. Underlying it in some places is 1.75-2.5 feet of gray silty clay with red-brown mottles. Siltstone underlies the colluvium. No water was found above bedrock. Total borrow is 20,000 yards. Six test pits were dug in this area. They are numbered TP 156 - TP 160 and TP 164.

Borrow Area "D"

Borrow Area D lies upstream from Area C, separated from it by an intervening area of shallow residual soil (Muskingum). Colluvium of the Leadvale Series makes up the borrow. 4.0-8.5 feet of sandy silt to clayey gravel with shale and siltstone pebbles overlies 1.7-2.5 feet of clayey silt to silty clay. Sandstone and siltstone underlie the colluvium. There was no water table here at the time of investigation. This colluvial fan contains 20,000 cubic yards of borrow. Three test pits were dug in this area. They are TP 172 to TP 174.

Borrow Area "E"

The flat-topped ridge between Beetle Run and Alum Run was investigated as a source of borrow material. Red weathered siltstone and sandstone 0.5-4.7 feet thick, underlies this area (Lehew Series). Small bodies of clayey gravel or sandy silt with gravel lie within this residual area. The gravel includes subangular to subrounded pebbles and cobbles of siltstone and sandstone. This deposit, 0.3 to 4.5 feet

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nick, is old terrace alluvium (Holston Series). A small area of colluvial clayey silt (Leadvale), light gray with red mottles, occupies the end of this ridge. It is 4.5 feet thick. 30,000 cubic yards of borrow are present in this area. Nine test pits were dug numbered TP 101 to TP 109.

Borrow Area "F"

Alluvial borrow along the main stream of Beetle Run is here designated as borrow Area F. It extends 3600 feet upstream from the § dam. This alluvium includes red-brown to gray silty gravel, 1.7-5.0 feet thick, with pebbles and cobbles of shale and sandstone. This layer usually lies directly above bedrock although occasionally it forms the top layer. In other places clayey gravel, usually light gray with variegated mottling is the bottom layer, 1.0-3.5 feet thick. Mottled gray and brown or yellow CL or ML, 1.5-4.0 feet thick, overlies the gravel. Above this is red-brown silty sand, 1.5-5.0 feet thick, or red-brown CL-ML, 1.5-3.8 feet thick. Locally the gray, mottled CL-ML is the surface layer. At the time of investigation, no water was encountered in about half of this area. In the remainder of the alluvium, water generally lies on top of weathered rock or in coarse GM material just above bedrock. Borrow totals 93,000 cubic yards or more in this area. Twenty seven test pits were dug in this area. They are TP 110-112, TP 114-117, TP 122, TP 124-126, TP 129-130, TP 133-135, TP 150-151, TP 154-156, TP 161-163, TP 167-168, TP 170-171, and TP 175.

Borrow Area "G"

Borrow Area G extends 1600 feet up Alum Run from its juncture with Beetle Run. Alluvial material makes up this borrow area. Red-brown silty gravel, 2.0-3.0 feet thick, overlies shale and siltstone in some places and brown and gray-mottled GC (2.5-3.0 feet thick) overlies rock in others. Above this is silty clay or clayey silt, light gray with brown or yellow-red mottles, 1.25-2.5 feet thick. The top layer is red-brown silty sand, 1.0-3.5 feet thick. As along Beetle Run, one or more of these layers may be absent in places. The water table generally lies just above rock. Borrow totals 20,000 cubic yards. Thirteen test pits were dug in this area. They are TP 136-137 and TP 139-149.

APPENDIX VII

STABILITY ANALYSES

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		SUMMARY - SLOPE STABILITY ANALYSIS	
PROJECT and STATE TONY CREEK SITE #10 VIRGINIA		METHOD OF ANALYSIS SWEDISH CIRCLE & BLOCK		DATE 10-29-70	
SOURCE AND USE OF MATERIALS	CLASSIFICATION	ADOPTED	DESIGN	DATA	REMARKS
TRIAL NO.	SLOPE	CONDITIONS	CONDITIONS	F_s	
1 Up	25:1/3:1	Full drawdown-10' berms @ elev 5.1277.9	Full drawdown-10' berms @ elev 5.1277.9 - All cut thru * Zoned emb only.	1.35	
2 Up	25:1/3:1	Same conditions as trial #1.	Refer to sheet 3 of 5	1.35	
3 Up	25:1/3:1	Same conditions as trial #1.		1.35	
4 Up	25:1/3:1	Full drawdown-10' berms @ elev 5.1277.9	Full drawdown-10' berms @ elev 5.1277.9 - All cut thru * Zoned emb. 5' found (35% - 0).	1.35	
5 Up	25:1/3:1	Same conditions as trial #1.		1.34	
6 Up	25:1/3:1	Same conditions as trial #1.		1.34	
7 Down	25:1/1	Drain @ 9% = 0.6 - 10' berm @ elev 5.1288.5	Drain @ 9% = 0.6 - 10' berm @ elev 5.1288.5 - All cut thru * Zoned emb. only.	1.34	
8 Down	25:1/1	Same conditions as trial #7		1.52	
9 Down	25:1/1	Same conditions as trial #7		1.52	
10 Down	25:1/1	Drain @ 9% = 0.6 - 10' berm @ elev 5.1288.5	Drain @ 9% = 0.6 - 10' berm @ elev 5.1288.5 - All cut thru * Zoned emb. 5' found (35% - 0).	1.62	
11 Down	25:1/1	Same conditions as trial #10.		1.62	
12 Down	25:1/1	Same conditions as trial #10.		1.62	
13 Up	25:1/3:1	Block Analysis - Some conditions as trial #4. Better to sheet 4 of 5		1.45	
14 Up	25:1/3:1	Same conditions as trial #13.		1.45	
15 Up	25:1/3:1	Same conditions as trial #12.		1.45	
16 Down	25:1/3:1	Block Analysis - Some conditions as trial #10.		1.80	
17 Down	25:1/3:1	Same conditions as trial #16.		1.75	
18 Down	25:1/3:1	Same conditions as trial #16.		1.90	

